

***Batrachedra smilacis* sp. nov.** (Gelechioidea, Coleophoridae *s. l.*), whose larva is frequently detected in inspections of *Smilax china* (Smilacaceae) imported from China as a fruit-borer

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**Abstract** *Batrachedra smilacis* sp. nov. is described on the basis of specimens reared from fruit-borers on *Smilax china* imported from China and inspected at the Plant Protection Station at Nagoya Seaport, Japan. Descriptions and illustrations are provided for the larval and pupal morphology as well as for the adult one. On the basis of several character states, the new species apparently belongs to the clade named by Kaila (2004) “the core *Batrachedra*”. Several immature character states that may be additional apomorphies supporting the core *Batrachedra* are mentioned. Larvae of the new species are frequently detected in inspections of *Smilax china* imported from China at the Plant Protection Station. Some male and female specimens, which are quite similar to the new species in the genitalia but distinctly larger than the type specimens, were collected at several localities in Japan. These Japanese specimens are left untreated until their immature stages are discovered.

**Key words** Silk-threads from cocoon, spines on larval fore femur, pupal abdomen, dorsal condyles, paired projections on abdominal terminal, cremaster.

The genus *Batrachedra* Herrich-Schäffer, 1853 is a group of very small to small gelechioid moths, which has linear or linear-lanceolate wings with the forewing radial vein only four-branched. Approximately 140 species are currently placed in the genus. Morphologically, the genus is best diagnosed by the female genitalia: the cephalic corners of the eighth sternite extend as sclerotized bars, which are fused to the medial part of the apophysis anterioris; the cephalic half of the ductus bursae has an area lined with dense strong spines; an accessory pouch arises from around the caudal end of the corpus bursae. Detailed diagnoses are available in the literature: *e. g.* Hodges, 1966; Koster & Sinev, 2003; Sugisima, 2005. Larval feeding habit varies considerably within the genus (Hodges, 1966; Common, 1990; Koster & Sinev, 2003): many species feed on reproductive organs of plants such as flowers, fruits, and fern-spores; not a few species are associated with palms; some are reported to live on scale insects or aphids. Information on the immature morphology is available in the literature for only five species: Kaila (2004) gave the larval and pupal characters of an Australian species, *B. eustola* Meyrick, 1897, and two Palaearctic species, *B. pinicolella* (Zeller, 1839) and *B. praeangusta* (Haworth, 1828) in the form of a character matrix; Patočka & Turčáni (2005) illustrated the pupa of *B. pinicolella* and *B. praeangusta*; Stehr (1987) gave a sketch of the whole caterpillar of a Mexican species, *B. linaria* Clarke, 1957, from which the body chaetotaxy is detectable to some extent; Sánchez-Soto & Nakano (2004) described the egg, larva and pupa of a Brazilian species, *B. nuciferae* Hodges, 1966.

In 2002, I received from the Plant Protection Station at Nagoya Seaport, Japan, a request for identification of gelechioid moths reared from fruit-borers on *Smilax china* imported from China. After examining the moth specimens, I concluded that they represented an unnamed species of *Batrachedra*. In 2003, I obtained larval and pupal samples of the species from the Plant Protection Station at Nagoya Seaport.

In the present paper, I describe the *Batrachedra* species on fruits of imported *S. china* as

new, with the larval and pupal morphology of the species. Then I discuss whether the new species is referable to the core *Batrachedra* of Kaila (2004), and mention several character states of immature stages that may be additional apomorphies supporting the core *Batrachedra*. With regard to the family placement of the genus *Batrachedra*, I follow Kaila (2004) and assign it to Coleophoridae *sensu lato*.

## Material

Larval specimens of the new species were collected in the course of inspections by the Plant Protection Station at Nagoya Seaport as fruit-borers on *Smilax china* imported from China. Pupal and moth specimens were obtained through rearing the fruit-borers at the Plant Protection Station (*i. e.* no specimens were collected at ‘normal’ localities in Japan).

Mainly for the purpose of discussing immature character states supposed to be additional apomorphies supporting the core *Batrachedra*, I examined the larval and pupal specimens of an Oriental palm-pest species conventionally identified as *B. arenosella* (Walker, 1864) (see Sugisima, 2005). The larvae of this palm-pest were collected by me at the campus of Osaka Prefecture University as fruit-borers on *Trachycarpus fortunei* (Arecaceae), and the pupal specimens were obtained through rearing the fruit-borers. I observed the immature biology of the palm-pest through rearing.

All specimens of the new species and most specimens of the palm-pest used in this study are deposited in the Entomology Laboratory, Osaka Prefecture University, Sakai, Ôsaka, Japan.

## Taxonomy

### *Batrachedra smilacis* sp. nov. (Figs 1–33)

Specimens examined.

Adult. Holotype: ♀, labelled “Date 2000.XI.15; at NAGOYA P. T.; by K. YAMAMOTO” “from CHINA; Host *Smilax china*” “♀ genitalia slide no. 0999, K. Sugisima, 2002” “wings ♀ slide no. 1357, K. Sugisima, 2003” [slide labelled as follows: ♀ genitalia/wings; slide no. 0999/1357; K. Sugisima, 2002/2003; reared from larva found in the course of inspection by the Nagoya Plant Protection Station of Nagoya Seaport; larva fed on fruit of *Smilax china* exported from China; 15. xi. 2000 (inspected); K. Yamamoto leg.]. Paratype: 1 ♂, the data same as the holotype, except for the numbers and symbols of slide labels (♂, genitalia 0998, wings 1356).

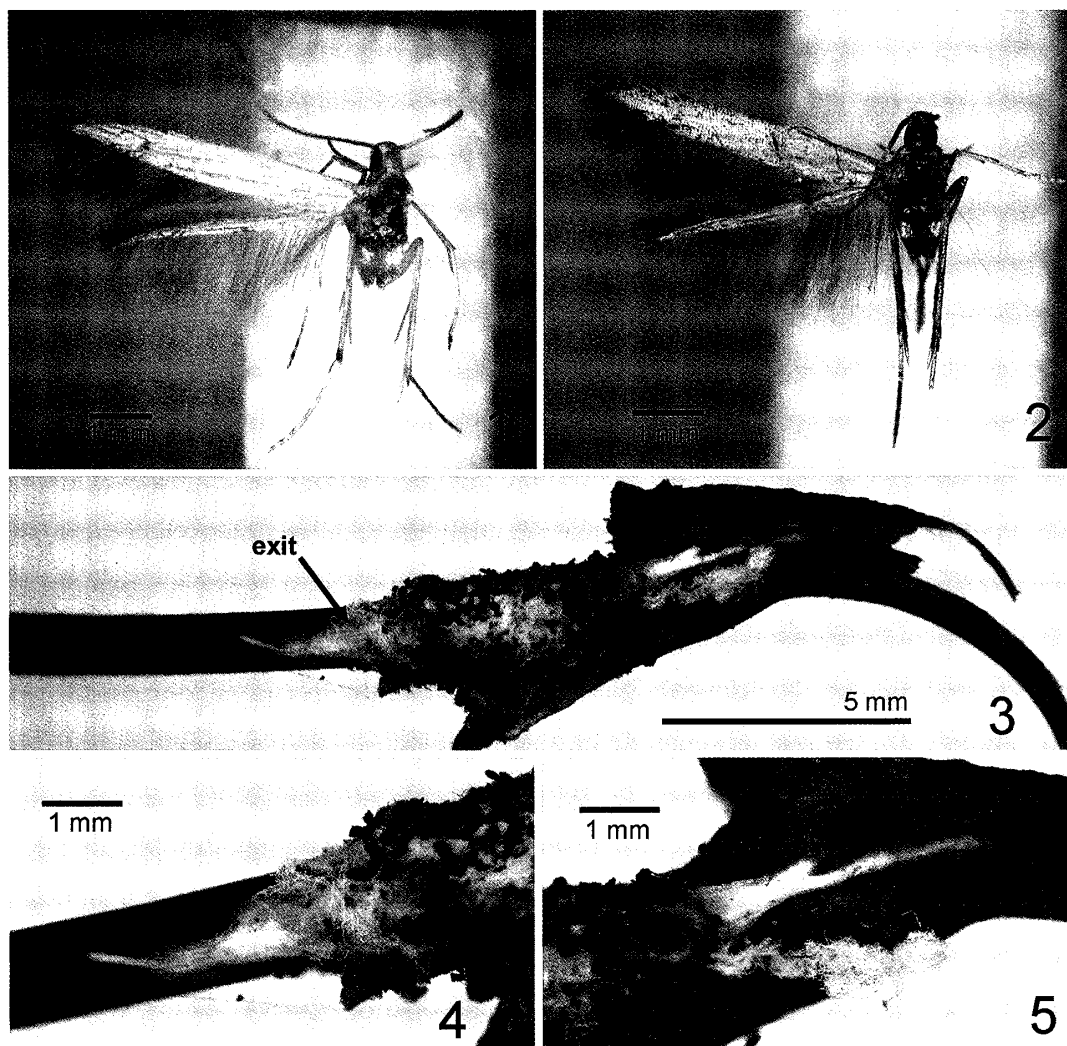
Larva. Five mature larvae, all mounted on slides nos 1330, 1331, 1332 and 1571 of K. Sugisima, exported from Shanghai, 11. xi. 2002 (inspection).

Cocoon. One sample, constructed by larva inspected on 9 October 2003.

Pupa. Three exs, 9. x. 2003 (inspection), 22–30. x. 2003 (pupation).

## Diagnosis

Medium-sized for *Batrachedra*-species. Head and thorax appearing paler-coloured than forewing because of absence of dark brownish scales. Forewing pale ochreous, dusted with dark brownish scales, except on a linear area from middle of costa to termen near apex; linear area appearing to be a yellowish streak. Male genitalia: uncus short triangular, about 2/5 as long as valva; valva with dorsal margin straight, and with a few short and stiff setae



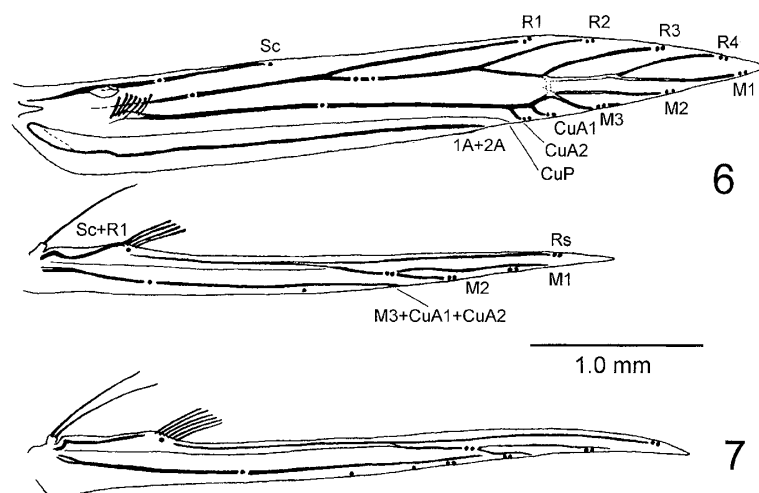
Figs 1–5. *Batrachedra smilacis* sp. nov. 1–2. Moth specimens. 1: ♀ (holotype); 2: ♂ (paratype). 3–5. Cocoon constructed on late October 2003 by larva inspected on 9 October. 3: whole cocoon (exit indicating where the moth emerged); 4 & 5: magnified view of cephalic and caudal areas, showing thread-like extension of cocoon ends.

around 4/5 near ventral margin; phallus about 2.3 length of valva. Female genitalia: ductus seminalis branching off around middle of ductus bursae; strongly spined area of ductus bursae occupies cephalic 1/4; corpus bursae small for *Batrachedra*-species, pear-shaped, with well-developed spatulate accessory pouch.

Adult (Figs 1, 2, 6–16)

Forewing length. ♂ 4.4 mm, ♀ 4.7 mm (holotype).

Colouration (Figs 1, 2). Head pale grey-ochreous. Labial palpus pale ochreous; second and third segments outwards with two broad dark brownish bands, one in basal half and the other in apical half. Forewing pale ochreous, suffused with dark brown along basal 1/2 of costa, mottled with dark brownish scales except for a linear area, which ranges from the middle of costa to the termen just near the apex; this linear area appearing to be a yellowish streak; dark brownish scales denser in apical half. Although many *Batrachedra* species have a blackish patch around 1/3 of the forewing, it is uncertain whether it is present or ab-



Figs 6–7. Wing structures of *Batrachedra smilacis* sp. nov. 6. ♂ (paratype), slide no. 1356 of K. Sugisima. 7. ♀ (holotype), hindwing only, slide no. 1357 of K. Sugisima.

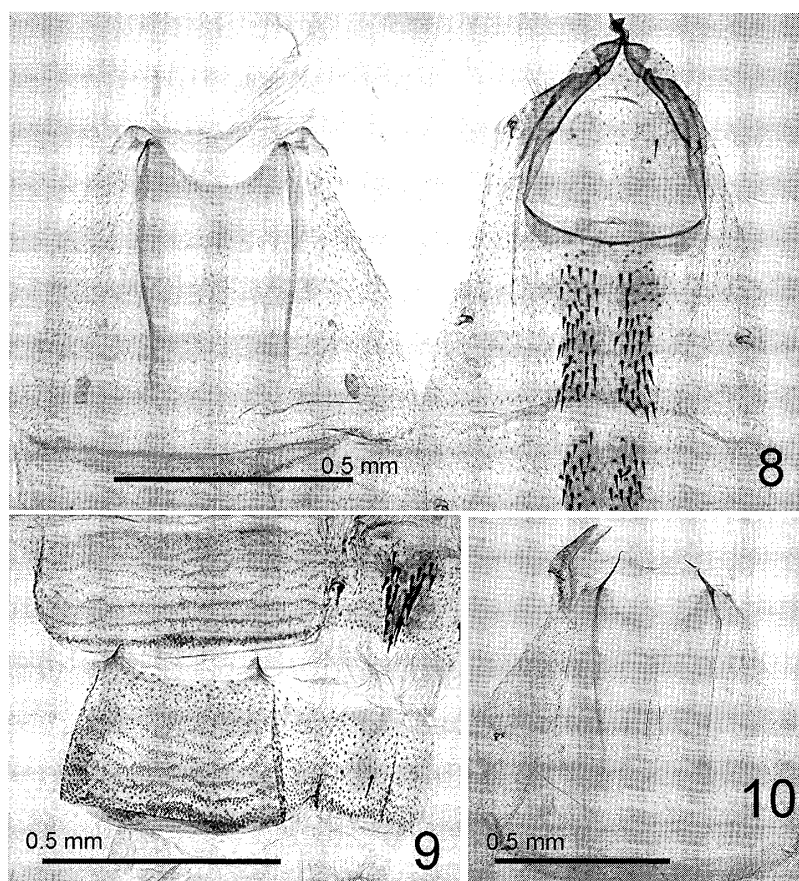


Fig. 8–10. Abdominal segments of *Batrachedra smilacis* sp. nov., laterally cut and unrolled, tergites on right, sternites on left. 8. ♂ (paratype), slide no. 0998 of K. Sugisima, first and second segments. 9. *Ditto*, seventh and eighth segments. 10. ♀ (holotype), slide no. 0999 of K. Sugisima, first and second sternite.

sent in the present species, because the basal area of the forewing is worn in the specimens examined.

Wing structure (Figs 6, 7). Forewing:  $R_{4+5}$  and  $M_1$  with long common stem, which arises from the anterior corner of cell, just near the base of  $R_3$ ;  $M_2$  and  $M_3$  arising from posterior corner of cell;  $CuA_1$  and  $CuA_2$  present, almost parallel; anterior branch of basal fork of anal vein indistinct. Hindwing:  $M_1$  and  $M_2$  with long common stem, which arises from beyond middle of  $R_s$ ;  $M_3$ ,  $CuA_1$  and  $CuA_2$  fused into a single vein. Wing locking system: frenulum composed of a single bristle in male, two bristles in female; posterior elements of retinaculum composed of a row of slender stiff scales along basal part of  $CuA$ ; costal margin of hindwing convex and ornamented with very long scales around 1/6.

Non-genital abdomen (Figs 8–10). Abdominal supporting system: ventral elements composed of venulae only in male, cephalic end of venulae extending as a long needle-like apodeme in female; in both sexes, a setose and heavily sclerotized plate (Fig. 10) situated between cephalo-lateral corners of sternite and tergite, articulated with corners. Eighth sternite of male (Fig. 9) more heavily sclerotized than in other segments, with cephalo-lateral corners projecting cephalically to form a short apodeme.

Male genitalia (Figs 12–16). Uncus triangular, twice as long as its basal width, about 2/5 length of valva, with pointed apex. Gnathos nearly as long as uncus. Valva almost parallel-sided from base to 3/4, thence ventral margin curving towards round apex while dorsal margin straight; around 4/5 near ventral margin a group of a few short stiff setae present. Anellus lobe moderate in thickness. Phallus (aedeagus in traditional usage) slender, about 2.3 length of valva, curving in apical 1/4, without membranous sides.

Female genitalia (Fig. 11). Apophyses almost equally long. Ductus bursae weakly sclerotized, sparsely spined on inner surface, and moderately narrowing from ostium towards middle, from which the ductus seminalis branches off. Cephalic half of ductus bursae equally narrow, membranous, smooth in caudal half, lined with dense strong spines in cephalic half (*i. e.* in cephalic 1/4 of whole ductus). Corpus bursae somewhat small for *Batrachedra*-species, pear-shaped, *i. e.* indistinctly divided into smaller and smoothly membranous caudal part and larger cephalic part; the latter part sparsely spined, with a signum of ellipsoidal dentate plate; accessory pouch arising from caudal part, fairly well-developed, distinctly spatulate.

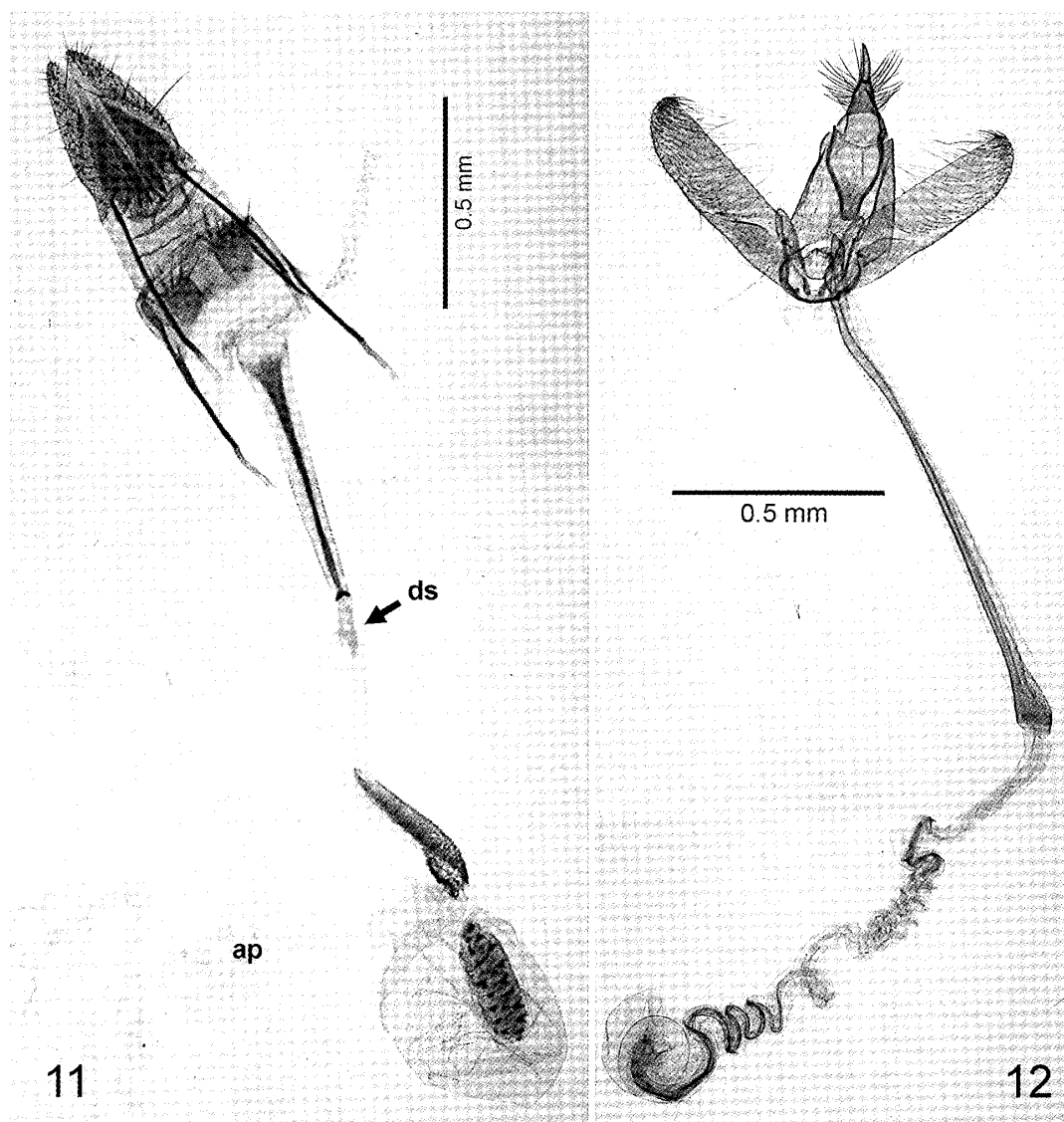
Mature larva (Figs 17–28)

Length 6.8–8.0 mm.

Head (Figs 17–23).  $P_1$  longest,  $A_3$  and  $S_2$  second longest,  $A_1$  fourth longest;  $AF_2$  longer than  $AF_1$ ;  $C_2$  longer than  $C_1$ . Labrum (Figs 18, 19): dorsal surface with six setae on each end, two of them distinctly long; ventral surface with three stiff fangs on each side. Mandible (Fig. 20) five-teethed, with two setae of different length. Antenna (Figs 21, 22) with first segment short and weakly sclerotized, with second and third segments strongly sclerotized; a very long hair arising from apex of outer surface of second segment. Submental pit present as a round concavity (Fig. 23). Maxilla-labium-complex (Figs 23, 24) rather typical for larva of Lepidoptera.

Thoracic legs (Fig. 25). Cephalo-mesial surface of fore femur with a patch of fine spines, which are absent in mid and hind legs. Apex of tarsus with two spatulate setae in all legs.

Prolegs (Figs 26, 27). Crochets of third to sixth abdominal segments 30–40 in number, uni-serial, uni- or bi-ordinal, and arranged in circle (Fig. 26), but that of last segment about 20



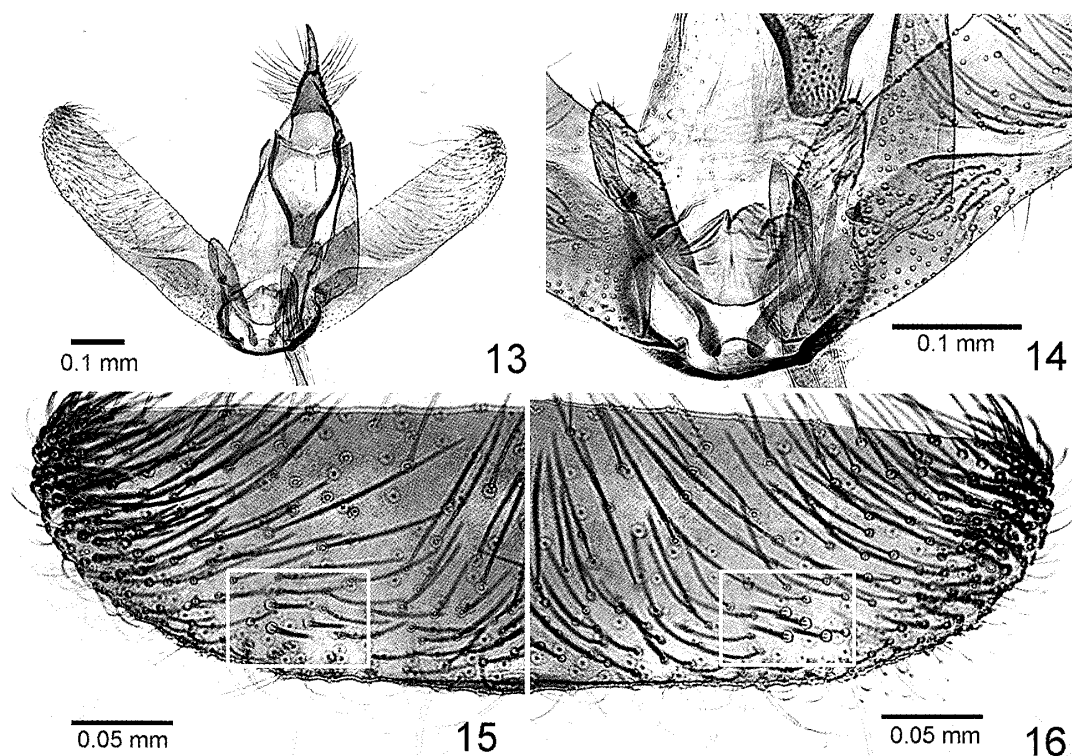
Figs 11–12. Genitalia of *Batrachedra smilacis* sp. nov. 11. Female, holotype, slide no. 0999 of K. Sugisima (ds: inception of ductus seminalis; ap: accessory pouch). 12. Male, paratype, slide no. 0998 of K. Sugisima.

in number, uni-serial, uni-ordinal, arranged in a cephalic transverse band (Fig. 27).

Body chaetotaxy (Fig. 28). Prothorax: D2 and SD1 very long; L1 by far longest in L-group; L2 and L3 almost on a horizontal line; SV1 much longer than SV2. Meso- and Metathorax: SD2 much shorter than SD1 and as long as D1; L-group almost on an oblique line. First to eighth abdominal segments: a minute pore and vestigial SD2 present just near base of SD1; SV1 present in all segments, long; other SV-group seta(e) rarely present in first segment, composed of two short setae in second to seventh segments, composed of one short seta in seventh segment, and absent in eighth segment. Ninth abdominal segment: D2 and L1 very long, robust; SD1 long, very thin.

Pupa (Figs 29–33)

Length 5.3–6.2 mm.



Figs 13–16. Magnified view of ♂ genitalia of *Batrachedra smilacis* sp. nov., paratype, slide no. 0998 of K. Sugisima. 13. Genitalia except phallus. 14. Juxta and anellus lobes. 15 & 16. Apical 1/3 of left and right valva, with area bearing short stiff setae surrounded by square.

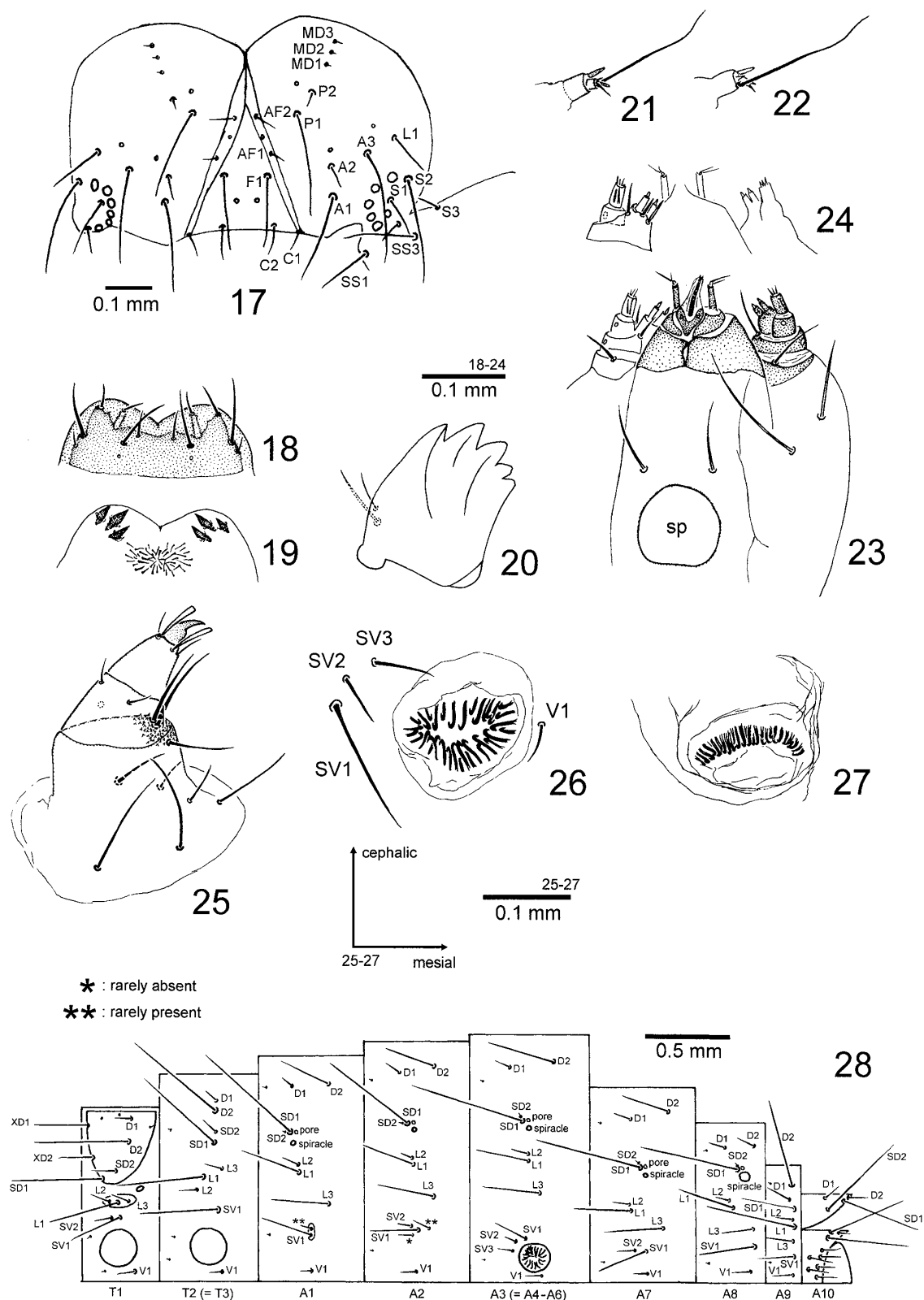
Elongate spindle-shaped, widest on second abdominal segment, thickest on second or third abdominal segments. Labial palpi visible between proboscis. Maxillary palpi visible. Antennae distant from each other. Fore legs with apex cephalically of apex of proboscis; femur visible. Mid legs extending near caudal end of fourth abdominal segment. Hind legs extending around cephalic margin of sixth abdominal sternite and beyond apex of antennae, not divergent apically. In abdomen, fourth, fifth and sixth segments movable, while the dorso-ventral movement is inhibited by strongly convex cephalic margins of fifth, sixth and seventh tergites called by Kaila (2004) the dorsal condyles; dorsal setae on the fourth to seventh segments longer and stiffer than those on other segments and apically hooked (Fig. 30). Abdomen ventro-laterally with a pair of blunt longitudinal ridges. Abdominal terminal (Figs 32, 33) dorsally with a pair of strongly sclerotized and heavily melanized projections, ventrally with a hump ornamented with many hooked bristles; true cremaster absent.

### Biology

Foodplant: *Smilax china* Linnaeus (Smilacaceae). The larva is a fruit-borer. The mature larva leaves the fruit and makes a spindle-shaped cocoon, from both ends of which a conspicuous silk-thread extends almost along the longitudinal axis of the cocoon (Figs 3–5). Larvae are frequently detected in inspections of *S. china* imported from China at the Plant Protection Station at Nagoya Seaport (K. Tanaka, *pers. comm.*).

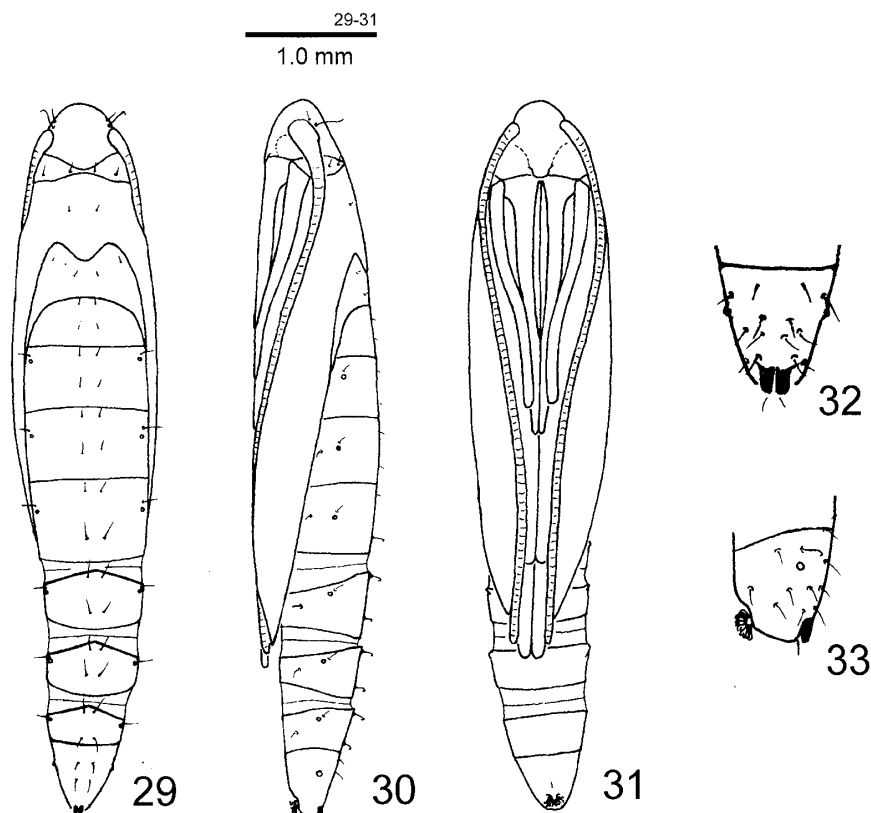
### Remarks

In appearance, *Batrachedra smilacis* may be confused with an Oriental species known as a pest of coconut palms and conventionally identified as *B. arenosella* (Walker, 1864). In the



Figs 17-28. Mature larva of *Batrachedra smilacis* sp. nov. 17. Setae of head capsule (deformation resulted from being mounted on slide). 18. Labrum, dorsal surface. 19. Labrum, ventral surface. 20. Mandible, inner surface. 21. Antenna, inner surface. 22. Antenna, outer surface. 23. Maxilla-labium-complex and submentum, ventral surface (sp: submental pit). 24.





Figs 29–33. Pupa of *Batrachedra smilacis* sp. nov., inspection on 9. X. 2003, pupated on 22. X. 2003. 29. Dorsal view. 30. Lateral view. 31. Ventral view. 32. Abdominal terminal magnified, dorsal view. 33. *Ditto*, lateral view.

genitalia, *B. smilacis* can be distinguished from the palm-pest in the male by the short uncus being  $2/5$  as long as the valva and very slender phallus being  $2.3$  length of the valva, in the female by the ductus seminalis branching off from the middle of the ductus bursae and the pear-shaped corpus bursae. In the palm-pest, the uncus is  $3/5$  as long as the valva, the phallus is as long as the valva, the ductus seminalis branches off from around caudal  $1/8$  of the ductus bursae, and the corpus bursae is oval.

Some male and female specimens collected at some localities in Japan, from Kyûsyû to Hokkaidô, are quite similar to the new species in the genitalia, but they are distinctly larger than the type specimens (K. Sugisima, unpublished data). These Japanese specimens are left untreated until their immature stages are revealed.

## Discussion

Kaila (2004) threw doubt on the monophyly of species currently placed in *Batrachedra*, because his phylogenetic analysis of three *Batrachedra* and 140 gelechioid species of other genera resulted in a hypothesis that an Australian species, *B. eustola*, was closer to the

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Maxilla, dorsal surface. 25. Right fore leg, caudal view. 26. Right proleg of third abdominal segment, ventral view. 27. Right anal proleg, ventral view. 28. Setal map. Slides no. 1571 of K. Sugisima for Fig. 17, no. 1331 for Figs 18–26, no. 1332 for Fig. 27; Fig. 28 constructed mainly on slide no. 1332, taking other specimens into consideration.

species of other genera than to two Palaearctic *Batrachedra* species, *B. pinicolella* and *B. praeangusta* (the type species of *Batrachedra*). The latter two species were supposed to form a fairly strong clade, which he named the core *Batrachedra*. This clade was supported by nine apomorphies (Kaila, 2004: fig. 3, appendix A): 1) the inception of the adult antenna nearly touches the eye; 2) the adult parapetiole is modified into a coremata; 3) lateral extension of pre-episternum medially has a membranous window; 4) the male and female forewing has a row of cephalically directed slender scales on the ventral surface along the CuA; 5) the phallus is a sclerotized tube, without membranous sides; 6) the pupal antennae are distant from each other; 7) the pupal abdominal segments have the dorsal and ventral condyles, which prevent the abdomen from moving dorso-ventrally; 8) the pupal abdomen has lateral ridges; 9) the L3 seta of the larval prothorax is placed ventro-caudally of L2. The second and seventh of these nine apomorphies were regarded as unique to the core *Batrachedra* within Gelechioidea.

In the present study, it is not confirmed whether *B. smilacis* has the second and third of the nine apomorphies supporting the core *Batrachedra*, because the scarcity of the adult specimens prevented me from checking characters that require for observations serious damage to the specimen. Among the other seven apomorphies, six are observed in *B. smilacis*: the first, fourth, fifth, sixth, seventh and eighth. Particularly, the seventh (*i. e.* the dorsal condyles on the pupal abdominal segments) is one of the two apomorphies unique to the core *Batrachedra*. On the other hand, the ninth (*i. e.* the larval prothoracic seta L3 situated ventro-caudally of L2) conflicts with the character states observed in *B. smilacis*. The relative position of the larval prothoracic L2 and L3 is apparently a rather ambiguous character. The two setae are situated roughly on a single horizontal line, and there are few lepidopteran species with the L3 distinctly ventrally or dorsally of L2. Consequently, it is very likely that *B. smilacis* belongs to the core *Batrachedra*, while it must be confirmed whether *B. smilacis* has the second and third of the nine apomorphies supporting the core *Batrachedra* when additional adult specimens are eventually accumulated.

Besides *B. smilacis*, I examined the larval and pupal morphology of an Oriental palm-pest species conventionally identified as *B. arenosella* (Walker, 1864) and observed its immature biology (unpublished data). The Oriental palm-pest shared with *B. smilacis* several immature character states, which were not used by Kaila (2004): a conspicuous silk-thread extends from both ends of the cocoon; the larval fore femur has a patch of fine spines on the cephalo-mesial surface; the tarsus of the larval thoracic legs apically has two spatulate setae; the dorsal setae on the fourth to seventh pupal abdominal segments are longer and stiffer than those on other segments and apically hooked; the pupal abdominal terminal dorsally has a pair of strongly sclerotized and heavily melanized projections, and ventrally has a hump ornamented with many hooked bristles. Sánchez-Soto & Nakano (2004) stated that the pupal abdominal terminal of a Brazilian species, *B. nuciferae*, had the same character states, and their pupal illustration showed that the dorsal seta of *B. nuciferae* are also of the same states as *B. smilacis* and the Oriental palm-pest. Patočka & Turčáni (2005) described and illustrated the pupa of *B. pinicolella* and *B. praeangusta*. Although the states of the setae on the dorsal surface were not detectable from their illustrations, they showed that the abdominal terminal of the two species had similar states, while their dorsal projections were not so conspicuous as the palm-pest and *B. smilacis* and the ventral hump of *B. praeangusta* had no bristles. Koster & Sinev (2003) illustrated the cocoon of *B. pinicolella*. The silk-thread from both ends of the cocoon are not recognized in their illustration; their illustration is given for emphasizing the excrements covering the cocoon. Except for the spatulate setae of the larval thoracic legs, the above-mentioned character states of the cocoon, larva and pupa are at most rarely known elsewhere within Gelechioidea, and thus

they may be additional apomorphies supporting the core *Batrachedra*. The spatulate setae of the larval thoracic legs have been observed in various families and are possibly associated with larval mode of life such as fruit-boring and leaf-mining (Nasu *et al.*, 2004). Therefore, this character state may be of little value for defining the clade.

## Acknowledgements

I thank K. Tanaka (the Plant Protection Station at Nagoya Seaport) for giving me the opportunity to study the present species, for providing me with larval and pupal specimens, and for letting me know how often the present species is detected at the Plant Protection Station at Nagoya Seaport. I thank Y. Muro for comments on an earlier draft. I thank F. Komai and Y. Nasu for critically reading the manuscript and giving many suggestions on it; I am grateful to the former person also for informing me of a very important publication.

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## 摘 要

サンキライホソキバガ (新称) (キバガ上科, 広義のツツミノガ科)—中国から輸入されたサンキライ (サルトリイバラ) の検疫において頻繁に発見される果実穿孔虫 (杉島一広)

中国から輸入された *Smilax china* サンキライ (サルトリイバラ) の果実穿孔虫を飼育して得られたキバガ上科小蛾について, 名古屋植物防疫所 (名古屋港構内) より同定依頼を受けた。標本を検討したところ, その小蛾はホソキバガ属の未記載種と判断されたため, 本報で幼虫および蛹の形態も含めて新種として記載した。

*Batrachedra smilacis* sp. nov. サンキライホソキバガ (新称) (Figs 1–33)

成虫. 前翅長は♀ 4.7 mm, ♂ 4.4 mm. 頭部と胸部は前翅に比べて明色に見える。前翅は淡黄褐色で, 暗褐色鱗片が散布されるため灰色がかって見える; ただし, 前縁中央と外縁翅端付近を結ぶ線上は暗褐色鱗片を欠くため黄色い縞様をなす。♂交尾器: uncusは幅広の三角形で, 長さはvalvaの長さの2/5; valva背縁はほぼ直線的で, 基部から4/5腹縁近くに数本の短く太い毛が固まって生える; phallusの長さはvalvaの約2.3倍。♀交尾器: ductus seminalisはductus bursaeのほぼ中央から分岐する; ductus bursaeの大

型棘群に裏打ちされた領域は ductus bursae の頭側 1/4 を占める; corpus bursae は洋梨型で, accessory pouch は良く発達し先端が膨らむ.

幼虫. 体長 6.8–8.0 mm. 前脚は前面正中線寄りに細かい棘群を持つ; 前胸 L 刺毛群は 3 本で, ほぼ同一水平線上に並ぶ; 腹部第 1, 2, 7, 8 節は SV3 刺毛を欠き, 腹部第 1, 8 節はさらに SV2 刺毛も欠く.

蛹. 体長 5.3–6.2 mm. 左右触角は接しない; 腹部第 4–7 節の背面側の刺毛は他に比べて太く長い; 腹部第 5, 6, 7 節背板前縁が前方に向かって張り出す; 腹端は背面側に 1 対の強く硬化した黒い突起を, 腹面側には先端が鈎状になった剛毛を密生する小突起を持つ.

繭: 紡錘形で, 前後両端から太い絹糸紐が延びる.

本種の幼虫は, 中国から輸入されるサンキライの検疫では頻繁に発見される. 日本国内の (輸入植物の検疫所を除く) 数地点において, 交尾器が本種に酷似するものの明らかに大型なホソキバガ属が, 雌雄数頭ずつ得られている. これら日本産の標本が本種に含まれるかどうかは, 日本のものの幼生期が明らかになるまで判断を保留する.

現在ホソキバガ属に含まれている種の単系統性については疑問視されているが (Kaila, 2004), 本種は Kaila (2004) が the core *Batrachedra* と名付けた, 属の模式種を含む単系統群に含まれると思われた. また, 本種および東洋区でヤシの害虫とされる同属種 (日本ではヤシトガリホソガの和名で呼ばれているもの) の繭・幼虫・蛹の形態を比較したところ, the core *Batrachedra* の単系統性を支持する共有派生形質かもしれない形質状態がいくつか見出された.

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